# PATENT COOPERATION TREATY

# PCT



## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| Applicant's or agent's file reference<br>2002M179 | **FOR FURTHER ACTION** | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| International application No.<br>PCT/EP 03/12881 | International filing date *(day/month/year)*<br>18.11.2003 | Priority date *(day/month/year)*<br>20.11.2002 |
| International Patent Classification (IPC) or both national classification and IPC<br>C07C51/36 | | |
| Applicant<br>EXXONMOBIL CHEMICAL PATENTS INC. et al | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 19.05.2004 | 19.04.2005 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office - P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk - Pays Bas<br>Tel. +31 70 340 - 2040 Tx: 31 651 epo nl<br>Fax: +31 70 340 - 3016 | Authorized Officer<br>Delanghe, P<br>Telephone No. +31 70 340-4119 |

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 03/12881

## I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

**Description, Pages**

| | |
|---|---|
| 1-30 | as originally filed |

**Claims, Numbers**

| | |
|---|---|
| 8-52 | as originally filed |
| 1-7 | received on 17.03.2005 with letter of 14.03.2005 |

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 1-48 |
| | No: | Claims | 49-52 |
| Inventive step (IS) | Yes: | Claims | 1-48 |
| | No: | Claims | 49-52 |
| Industrial applicability (IA) | Yes: | Claims | 1-52 |
| | No: | Claims | |

2. Citations and explanations

**see separate sheet**

**VI. Certain documents cited**

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

**see separate sheet**

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. **Documents**

Reference is made to the following documents:

D1: US-A-5 286 898 (1994-02-15)

D2: US-B1-6 284 917 (2001-09-04)

2. **Subject matter**

Claims 1-48 define a process for the hydrogenation with hydrogen of benzenepolycarboxylic acids or derivatives thereof, in the presence of a catalyst on a support. The catalyst support comprises one or more mesoporous materials (average pore diameter of 2-50 nm). Higher selectivity and less by-products ("lights") are obtained. Claims 49-52 define a cyclohexanepolycarboxylic acid, -ester or -anhydride or its composition obtained via the abovementioned process.

3. **Novelty**

The document D1 discloses (abstract, column 2, line 60 to column 5, line 6, examples 1-18, claims 1-8) the hydrogenation of dimethyl terephthalate using hydrogen and a ruthenium, nickel or platinum catalyst on an alumina support, having a pore diameter of 211 to 224 Å (21-22 nm). The subject matter of independent claim 1 differs from this D1 in that a catalyst support, comprising a mesoporous silica is used. Therefore, the subject-matter of claim 1 and of its dependent claims 2-48 is novel over D1 (Article 33(2) PCT).

The document D2 discloses (abstract, column 5, line 6 to column 6, line 41, column 7, line 58 to column 12, line 23, examples 1-14, claims 1-21) the hydrogenation of benzenepolycarboxylic acid or a derivative using hydrogen and a supported ruthenium catalyst in which the support is a mixture of a mesoporous and a macroporous support of aluminum oxide. The subject-matter of independent claim 1 differs from this D2 in that a catalyst support, comprising a mesoporous silica is used. Therefore, the subject-matter of claim 1 and of its dependent claims 2-48 is novel over D2 (Article 33(2) PCT).

Document D2 also defines cyclohexanepolycarboxylic acids its esters and its anhydrides for the use as plasticizers. Regarding the subject-matter of product claims 49-52, it is noted that the addition that a compound is prepared by a novel and inventive process, does not necessarily render the product (and composition) novel and inventive (see PCT guidelines 5.26 and 5.27). The subject-matter of claims 49-52 is not new over document D2 (Article 33(2) PCT).

4. **Inventive step**

As far as the claims are novel, the document D2 is regarded as being the closest prior art to the subject-matter of independent claim 1 (see above). The subject-matter of independent claim 1 differs in the type of support (ordered mesoporous silica) which is used.

The problem to be solved by the present invention may be regarded as an improved process for the hydrogenation of benzenepolycarboxylic acid or a derivative thereof, resulting in a higher reactionselectivity and lower by-products (e.g. "lights"). The use of a catalyst on a support comprising one or more ordered mesoporous silica makes an important contribution thereto.

The document D2 of the prior art does not disclose any process which solves the problem in the same way as the present application, namely by using a mesoporous silica as the catalyst support (preferably MCM-41). Thus, given the teaching of the prior art, the skilled person would not consider solving the problem in the same way as the present application. Therefore, the solution proposed in claim 1 and of its dependent claims 2-48 of the present application can be considered as involving an inventive step (Article 33(3) PCT).

## CLAIMS

1. A process for hydrogenating, to the corresponding cyclohexyl derivative, one or more benzenepolycarboxylic acids or one or more derivatives thereof, or a mixture of one or more benzenepolycarboxylic acids or one or more derivatives thereof by bringing the benzenepolycarboxylic acid or the derivative thereof or the mixture into contact with a hydrogen-containing gas in the presence of a catalyst, said catalyst comprising one or more catalytically active metals applied to a catalyst support comprising one or more ordered mesoporous materials, at least one of which materials is ordered mesoporous silica.

2. A process as claimed in claim 1 wherein the catalyst support further comprises one or more macroporous materials combined in admixture with the one or more ordered mesoporous materials.

3. A process as claimed in claim 1 wherein the catalyst support further comprises one or more mixed porosity materials combined in admixture with the one or more ordered mesoporous materials.

4. A process as claimed in claim 3 wherein the mixed porosity material contains mesopores and macropores.

5. A process as claimed in any one of claims 2 to 4 wherein the macroporous or mixed porosity materials are amorphous.

6. A process as claimed in any one of claims 2 to 5 wherein at least one of the macroporous or mixed porosity materials is alumina.

7. A process as claimed in any one of the preceding claims wherein the ordered mesoporous silica is a metallosilicate.